Does Existing Law Fail To Address Nanotechnoscience?

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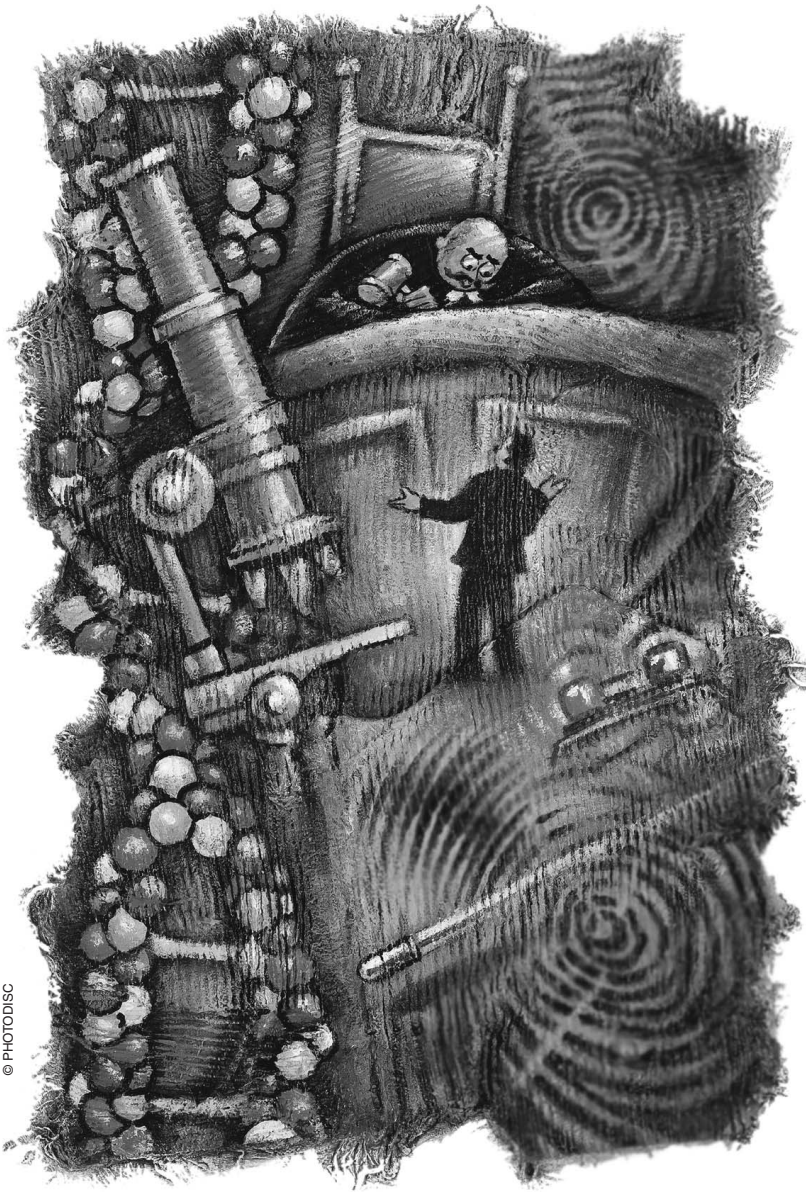

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The realm of nanotechnoscience (NTS) is vast and dense. Its inhabitants include numerous scientific fields and researchers, technical apparatuses, journals, list servs, electronic forums, governmental research initiatives, regional expertise hubs, triple helix networks, novels, visionary texts, philosophemes, futurological projections, goods, services, television commercials and at least one television program, films, venture capital groups, private enterprises and publicly-traded companies, military planners, trademarks, copyrights, and patents. A niche industry of *nanocritics* has arisen to address ethical principles that should govern the field, causal factors in that development, and the types of nanotechnological futures considered desirable. Although their visions of a nanotechnologized world vary considerably, commentators of many stripes share a concern about what they perceive as the same worrisome issue: a lack of appropriate ethical and legal principles and processes to guide nanotechnological R&D and commercialization.

Whether there really is such a gap in legal institutions, doctrines,

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and discourses is my subject. I agree with the nanocritics on the absence of legislation and other legal approaches specifically addressing the Do's and Do Not's of NTS, but I believe there is a large edifice of ethically imbued legal ideology, structures, and doctrines implicitly addressing and sanctioning commercially promising technological innovation. In making this case, I focus on the American ethical-legal terrain. I do not mean to marginalize other national and transnational domains, such as the Japan and the European Union 1], where significant R&D is taking place. However, as the planetary political-technological-cultural hegemon, the U.S. is probably going to exercise the greatest influence over the future of nanotechnology. And alongside American scientists and commentators, NTS future imaginaries are being predominantly propagated by American culture workers [2]-[6].

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Critics of Nanotechnoscience

The most organized and coherent critical voices within the NTS community lend themselves to a crude trinary grouping based on two tendencies. First, critics may be scattered along a gradient that runs from a belief in the inevitability of the development of powerful nanodevices and techniques to skepticism as to whether NTS will ever deliver on this potential. Second, critics differ in their degree of sympathy/opposition to the nano adventure. Three categories of critics are discernable: the inevitable opponent, the evitable proponent, and the evitable opponent.

Inevitable Opponent

Our first class of critic believes that NTS is inevitable and that society's most prudent course of action is some form of preparatory anticipation. The most prominent representative of this view is K. Eric Drexler, widely considered the Johnny Appleseed of NTS. Drexler initially harbored such intense concerns about the technical potentials that he refrained from speaking about his ideas [7]. Then, sobered by the likelihood of other theorists recognizing the promise of precise manipulation of matter at the nano-scale, Drexler co-founded The Foresight Institute, the first think-tank to focus specifically on NTS. Convinced that the potential would prove highly attractive to enterprise and government, Drexler facilitated development of ethical guidelines designed to steer nanotechnoscientists, their patrons, and society at large away from the worst foreseeable outcomes [8].

In the Drexlerian vision, during the earliest phases of R&D and commercialization, ethical-legal regulation should be largely absent because there is a risk that social actors and their institutions might regulate the technology clumsily. Instead, nanoscientists should voluntarily adhere to ethical guidelines while developing improved understandings and tools for NTS. Later in the development process, "boards of technical inquiries" [9, pp. 209-211] modeled on juridical fact-finding processes should generate a set of options for society at large. For Drexler, the governmental domain lacks the expertise to wrestle with the technical nature of NTS R&D, and would be better off awaiting digestible summaries of the nano terrain as produced by adversarial science courts based on the adjudication model.

Although it is necessary, the legal domain functions more as *ex post facto* ratifier and selector from among preformed technocratic visions of the good social life. Drexler's ideas thus parallel those of Francis Bacon's technocratic *New Atlantis* [10, pp. 135-172]. The juridical model that Drexler and other inevitable proponents seek is a legal environment that recognizes and accepts a subordinated relation to NTS R&D. As discussed below, what now prevails is not far from what they desire.

Though their visions differ in some respects, both Ray Kurzweil and the Center for Responsible Nanotechnology also function as inevitable proponents.

Evitable Proponent

A second class of critic focuses on the ways NTS could be derailed by a lack of appropriate legal and ethical parameters. In *Mind the Gap* [11], a report by three Canada-based bioethicists, there is said to be a dearth of ethical and legal precautions, guidelines, or principles guiding the new technology. Chastened by the global backlash against genetically modified organisms, the ethicists are more concerned with safeguarding the blossoming of NTS from similar pitfalls than with any particular legal framework, set of ethical guidelines, or social vision. Their clearly stated goal is dodging a repeat of the biotechnological academic-enterprise network's skirmishes with non-governmental organizations (NGOs), juridical hurdles, and other regulatory holdups.

Issues of equity, privacy, security, the environment, as well as metaphysical questions concerning

machine-augmented humans are considered reasons to "worry," but not reason to consider a moratorium or other truly constraining action. The ethicists' primary concern revolves around the belief that "there is a danger of derailing [NTS] if serious study of [NTS]'s ethical, [and] legal … implications…does not reach the speed of progress in the science" [11, p. R9]. It is a rather curious bioethics (or nanoethics?) that values the welfare of commercialized science over that of humans, or other life forms [12].

Perhaps also falling in the category of evitable proponent is legal scholar Glenn Reynolds. His earliest writings suggested that legislative passivity would be unwise, and that contemplating "the likely direction new technologies will take" and preparing "flexible legislation providing for appropriate regulatory schemes even before the products arrive in the market place" might be a better method of steering a path between "technology unregulated" and "technology undeveloped" [13]. His more recent works express a greater faith in the capacity of the NTS community to self-govern [14], [15], however, and suggest that he has crossed into the camp of inevitable proponents

Evitable Opponent

Advocates calling for bans and moratoriums — such as Sun Microsystems' Dr. Bill Joy and the ETC Group — comprise a critical class which, due to its relatively radical views, is much more widely, if also pejoratively, recognized as such. The opening volley came in 2000 when Joy published the article "Why the future doesn't need us" [16], the first widely read and culturally credible call for a ban on NTS R&D. Reacting in part against the enthusiasm of Ray Kurzweil for NTS and other technologies that could threaten our present understanding of what it means to be human [17], [18], Joy spoke out against the perils inherent in complex combinations of NTS, robotics, and genetic science. Joy argued it is "worthwhile to question whether we need to take such [a] high risk of total destruction to gain yet more knowledge and yet more things; common sense says that there is a limit to our material needs - and that certain knowledge is too dangerous and best forgotten," and that "[t]he only realistic alternative I see is relinquishment: to limit development of the technologies that are too dangerous, by limiting our pursuit of certain kinds of knowledge" [16, pp.258, 254].

A small literature intended partly to rebut Joy subsequently emerged [19]-[21], stimulated as well by the public attention accorded nanotechnology following Michael Crichton's sensationalistic treatment of the subject in the novel *Prey* [2]. It took almost three years for the first serious response from activists, however, when the ETC Group, an NGO devoted to the "conservation and sustainable advancement of cultural and ecological diversity and human rights," published *The Big Down: Atomtech-Technologies Converging at the Nanoscale*. This a lengthy expose described in detail the (then) current terrain of NTS, analyzed perceived perils (nanoparticle accumulation in living organisms and toxicity, for example), and offered policy recommendations. First and foremost among the recommendations is that "governments declare an immediate moratorium on commercial production of new nanomaterials and launch a transparent global process for evaluating the socio-economic, health and environmental implications of the technology" [22, p. 74]. Whereas Joy focused primarily on mature "assembler" technology (Drexler's molecular manufacturing) and the ETC Group's report illuminated the potential risks of both "structural" and "assembler" technologies, the two were in accord in thinking that a full development of NTS is not predetermined. Reflecting upon what they consider the perils of the technical potentials, this category of critic argues that the nano-R&D community be legally barred from continuing its work. Accordingly, desirable law for these nanocritics is radically curbing in its intent; R&D would be subjected to a moratorium or permanent ban (also see [23]).

Broader Ethical-Legal Terrain

Is the ETC Group's Executive Director, Pat Mooney, taken as a proxy agent of the nanocritics, correct when he asserts that "[t]he world's most powerful emerging technology is developing in an almost total political and regulatory vacuum" [24].

In a narrow sense, the claim is self-evidently correct: beyond fiscal appropriations and distribution protocols, no U.S. law speaks directly to the whither's and what for's of NTS. Even the *21st Century Nanotechnology Research and Development Act* is no exception, at least until there is more evidence of how it will actually be implemented. The Act has provisions — Sec. 2 (b) (10) (D) providing for "public input and outreach" via "regular and ongoing public discussions, through mechanisms such as citizens' panels"— which seem a potentially effective means of generating democratic visions of socially beneficial uses of NTS, but consider Jasanoff's criticism of citizen panels [25].

The Act also seeks establishment of "goals, priorities, and metrics for evaluation of Federal nanotechnology research, development, and other activities" [sec. 2 (a) (1)]. And it pledges "insofar as possible . . . (to) ensur[e] that advances in nanotechnology bring about improvements in quality of life for all Americans" [sec. (b) (10) (C)]. These are worthy ambitions, but are no more than nice phrases at this point.

More generally, there remains a shortage of scholarly reflection and

proposals for reasonable ethical-legal frameworks directly applicable to NTS *by name*. With the exception of the legal scholarship of Glenn Reynolds, discussed briefly above, jurisprudential reflection on NTS is quantitatively skimpy [23], [26] - [29].

The near univocal claim of an ethical-legal void appears less convincing, however, as one reflects on the longstanding American affinity for devices and artifacts. A more general perusal of the legal terrain — particularly post-1980 — finds it shot through with *implicit, latent, and embedded* ethics bearing directly on novel technologies as a class, and therefore affecting NTS.

A structurally conducive legal environment benefits NTS by a combination of doctrinal and institutional bias. If American society has long been technophilic, enthralled by the artificial [30] – [32] and the "technological sublime" [33], it should come as no surprise that the legal realm shares this tendency. Scholarly articles regularly and without explication place legal structures and technological structures in a hierarchical arrangement, in which the latter dominates [34], [35]. An affinity for technoscience can be found in the U.S. Constitution (Article One, Section 8, Clause 8) wherein Congress is granted the power to promote the "Progress of Science" before it is granted the power to declare war, raise and maintain an army, or establish lower courts. The Supreme Court's recent interpretations likewise grant a privileged position to technological innovation, particularly regarding questions of technology arising under the purview of Fourth Amendment privacy rights. In its 2001 Kyllo decision the Court ostensibly struck a strong blow for the Fourth Amendment protection of the home in opining the following rule: "We think that by obtaining by sense-enhancing technology any information regarding the interior of the home that could not otherwise have been obtained without physical intrusion into a constitutionally protected area [ ] constitutes a search —at least where [ ] the technology in question is not in general public use." But the ruling effectively links the fate of constitutionally guaranteed privacy of the home to the availability and use of novel technologies of surveillance. It would seem that this constitutional right now stands or falls according to the whims of technoscientific invention and dissemination [36].

Contemporary legislation bearing on novel technologies (see

TABLE I
Recent Legislation Promoting Technological Innovation

- Stevenson-Wydler Technology Innovation Act of 1980 (information dissemination)
- Small Business Innovation Development Act of 1982
- Cooperative Research Act of 1984 (diminishing the antitrust penalty of treble damages for companies that participate in joint pre-competitive research and development)
- Trademark Clarification Act of 1984 (facilitating patent licensing by nonprofit institutions)
- Federal Technology Transfer Act of 1986 (incentivizing federal employees)
- Omnibus Trade and Competitiveness Act of 1988 (encouraging public-private cooperation)
- National Institute of Standards and Technology Authorization Act of 1989
- Water Resources Development Act of 1988 (Army Corps of Engineers to fund research)
- National Competitiveness Technology Transfer Act of 1989 (adding technology transfer imperatives to the function of nuclear weapons laboratories)
- Defense Authorization Act of 1991 (encouraging national laboratories to demonstrate effective collaborative efforts among government and private entities)
- American Technology Preeminence Act of 1991 (liberalizing private-sector access to government intellectual property --"CRADA")
- Small Business Technology Transfer Act of 1992
- Defense Authorization Act of 1993 (facilitating technology transfer to small business)
- Defense Authorization Act of 1993 (establishing Office of Technology Transition)
- National Technology Transfer and Advancement Act of 1995 (further liberalizing private-sector access to government-owned innovations under a CRADA)
- Technology Transfer Commercialization Act of 2000 (allowing national laboratories to include extant government inventions in CRADA).

Table I) — particularly cooperative technology programs involving the "Triple Helix" of academia, industry, and government — continues to propagate this Constitutional affinity, and even intensify it [37]-[38]. The Bayh-Dole Act of 1980, for example, has effectively excised the traditional Constitutional emphasis on invention and implanted a set of commercial dissemination incentives, thereby adjusting not only the internal dynamics of the Triple Helix, but streamlining the trajectory from corporatized academic laboratories to the marketplace.

This drive to facilitate and provide incentives for the creation and distribution of emergent technologies also has induced institutional change. In 1982 Congress created the Court of Appeals for the Federal Circuit and granted it authority over all patent appeals, significantly reducing the transaction costs of forum shopping and minimizing the latent uncertainty intrinsic to the previous mosaic of jurisdictional authority. The Court has liberally interpreted patent statutes to allow expansion of patentable subject matter, as evinced in the *State Street Bank* case of 1996 that allowed patenting of mathematical algorithms so long as they produce something "useful." Commercialization and dissemination of novel technoscience has replaced enrichment of the public commons as the central impulse of domestic intellectual property policy. The last two decades of the twentieth century arguably saw more significant refinements to the patent system than any period since the introduction of the intellectual property clause into the Constitution. Coupled with the general American affinity for technology, this pro-invention, pro-commercialization legal atmosphere is the proverbial rising tide that raises all novel technologies, including NTS.

The legal domain also tends to idealize the technoscientific. Devices, systems, and techniques are understood solely as neutral artifacts, as tools capable of "good or bad" applications. The idea that this narrow perspective of technoscientific potentiality might miss broader cultural effects and other indirect harms is only recently dawning on a few legal minds [39]. The legal domain's failure to perceive that technoscientific innovation actually constitutes a form of legislation authoritatively shaping everyday life — a rival to government and law as a source of legislation — is perhaps the anchor of its technophilia [10].

NTS Critics Should Broaden Their Perspective

So, from one perspective, the nanocritics are correct: legal thought — legislative, juridical and academic, professional — bearing specifically on NTS by name is largely a null zone. But, from the perspective just outlined, the gravity of a dispersed and thematically coherent ethical-legal construct is clearly discernable. It encourages and incubates novel technologies as a species and is indifferent to individual titles, disciplinary position or marketing savvy; this edifice focuses on commercialized novelty. And based on the corpus of Supreme Court Fourth Amendment privacy case opinions, the law of the land finds the social implications of technological change, the effects on a central and cherished aspect of the American ethos, lamentable but acceptable. Regarding novel technology, this ethical-legal ether functions like the elementary algebraic theorem of the identity property for multiplication: in the same way that there exists a unique real number 1 which, when multiplied by any real number a, leaves a unchanged, the ether tends to work analogously as the multiplicative identity for commercializable R&D, leaving novel technologies pretty much as technology developers and entrepreneurs design them.

That nanocritics appear oblivious to this ethical and legal reality is unfortunate, even if understandable. To the extent they are concerned with shaping the impending NTS future, the critics should broaden their perspective on how ethical principles embedded in law are currently influencing relevant R&D and commercialization. Any attempt to fully address the regulation of NTS, as well as the more general recurrence of culturally and socially disruptive inventions, must come to grips with the distributed legal affinity described here. To the extent that law functions, in part, as a reservoir of desirable *ought's*, it would seem logical for a democratic community proactively to develop methods for addressing problematic aspects of technological change, rather than blindly encouraging "technology transfer."

An auspicious beginning would be an increase in the number of NGOs advocating at the intersection of law, ethics, and emerging technology. Institutions with such a focus would necessarily develop platforms and strategies that take into consideration the broader play of forces described above. As regards public institutions, we might experiment with extending state-level constitutional review powers to include the private sphere, so as to encompass non-public technological systems and devices. Such an expansion of constitutional purview beyond government agent action would help to situate novel technologies as social and political forces, and help to alleviate the simplistic view of neutrality underwritten by technophilia. But whether public or private, institutions capable of broadly engaging the emergence of novel technology are a dire social need. In our age perhaps no other phenomena so regularly forces us to reassess our societal goals and cultural commitments. In this sense, emerging technologies can be understood as challenging gifts. We are left to see whether our society is mature enough to manage them.

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CORRECTION

Due to a copyediting error, a book review of Emily Thompson's, *The Soundscape of Modernity*, published in the Fall 2004 issue of *IEEE Technology and Society Magazine*, listed the reviewer's name incorrectly. The reviewer was Doug Preis, not David Preis. We regret the error.